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MOUSE CONTROL IN FIELD AND ORCHARD



TO THE FARMER who has cared for his orchards and raised them to the age of profitable bearing, nothing could be more discouraging than to see his trees wither and die under the ravages of field mice. Nevertheless, thousands of valuable trees, both young and mature, are thus killed every year throughout the United States. Orchards are not the only scenes of such depredations, however, for the damage wrought by mice to pasturage, to forage, grain, and other crops, and to tubers, small fruits, flowering plants, and shrubbery amounts to millions of dollars annually. And much of it might be avoided. To describe methods for controlling mice in fields and orchards is the purpose of this bulletin. It supersedes Farmers' Bulletin No. 670.

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MOUSE CONTROL IN FIELD AND ORCHARD.

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INTRODUCTION.

THE CONTROL of field mice is needed continuously in many places, and at times it becomes imperative if farmers and fruit growers are to prevent ruinous losses of crops or trees. As a consequence, reliable information concerning methods of control is vitally important. The methods here recommended are the result of recent experiments, supplementing information previously accumulated by the Biological Survey.

A large proportion of the mouse injury to agricultural crops is inflicted by two kinds of short-tailed field mice, commonly known as meadow mice and pine mice,¹ although white-footed mice, house mice, and several other less common species occasionally occur in destructive numbers and become a menace to crops. The control methods here presented for the short-tailed mice are applicable to any of these mice under normal conditions.

MEADOW MICE AND PINE MICE COMPARED.

Although meadow mice and pine mice are very closely related, their habits differ considerably, and as these have a distinct bearing on control practices, it is important to identify each species. The range of meadow mice includes almost the whole of North America, but pine mice are restricted to the eastern United States from the Atlantic Coast to eastern Kansas and Nebraska, and from the Gulf

¹ The term "field mouse" has come to be generally used for the widely known meadow mouse (*Microtus*) and pine mouse (*Pitymys*), both of which have short tails, as opposed to the house mouse (*Mus*) and the white-footed mouse (*Peromyscus*) and other less common long-tailed mice.

of Mexico to the Great Lakes. The two forms may be distinguished readily by their appearance (fig. 1), by the nature of their burrows, and by the type of the injury done.

Both mice are blocky little animals with relatively coarse fur, usually dark brown in color, and with small, beady black eyes and almost concealed ears. The pine mouse, however, is somewhat the smaller, with less shaggy fur, more reddish-brown color, and a very short tail, approximately the same length as the hind foot, while the tail of the meadow mouse is usually nearly twice as long.²

The essential difference in the habits of the two forms is that the pine mouse is a burrowing animal, living and feeding very largely



FIG. 1.—A. Pine mouse; B. meadow mouse.

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under ground, while the meadow mouse, although making use of shallow tunnels and nesting chambers, feeds mostly at the surface. The presence of pine-mouse burrows may usually be detected only through the occasional small openings in the ground, but the well-known surface runs of the meadow mouse are clearly visible.

The nature of the feeding methods of the two species means that the major portion of injury inflicted by the meadow mouse is above the surface of the ground (fig. 2), while that of the pine mouse is

² The tail measurement is from the base to the end of the vertebrae, and the hind foot from the heel to the extreme end of the longest toe.

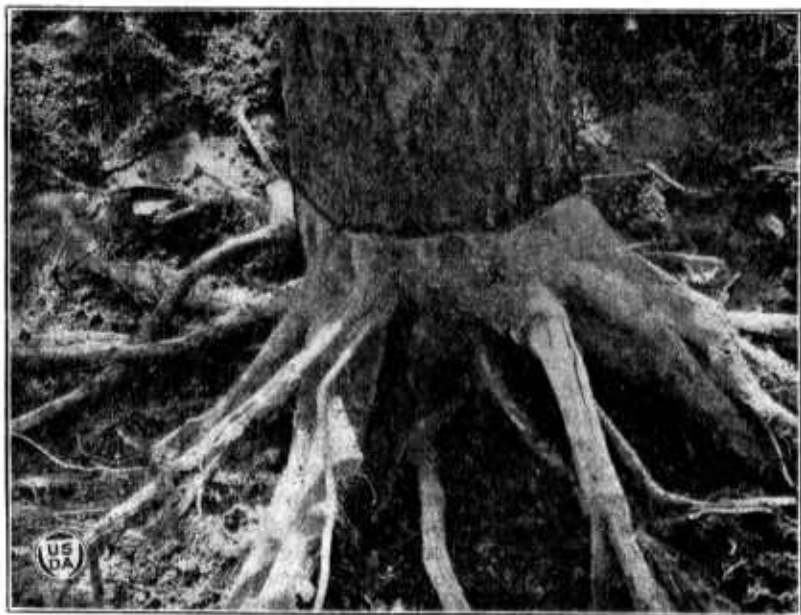
below (fig. 3), where, in the case of crops, it often remains unsuspected until harvest; or in orchards until the foliage of the undernourished, girdled trees begins to wilt.

The importance to orchardists of distinguishing between the two mice lies in the fact that mechanical protectors and clean cultivation around trees, which are successful aids to meadow-mouse control, have very little effect on pine mice, which do not rely on surface vegetation for food or protection. A knowledge of the pine mouse and its habits is also important to truck gardeners, florists, and others, who, thinking that its injury is



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FIG. 2.—A common type of meadow-mouse injury to small trees. Deep snow and lack of clean cultivation enable the mice to work above the ground level without fear of detection.



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FIG. 3.—Usual type of pine-mouse injury to large fruit trees. The soil has been removed before photographing in order to show the otherwise hidden injury by this mouse.

caused by moles, have tried unsuccessfully to check the depredations by use of mole traps.

FIELD-MOUSE INJURY.

The injury inflicted by field mice varies greatly from year to year, depending upon their abundance, the extent and nature of their food supply, and the weather conditions. The fluctuation in the numbers of the mice is frequent, irregular, and abrupt, owing to the varying birth rate, the effect of disease, the abundance of food, and the extent to which they are preyed upon by their enemies among wild birds, mammals, and snakes. Thus, the mere presence of these animals constitutes a menace requiring continual close observation. The orchardist especially stands liable to heavy losses from even

relatively little gnawing at vital points.

As a rule, the greatest damage to trees is committed during the winter months under cover of snow. Damage is usually more severe, therefore, during a hard winter with deep snow than during a mild one. The rule is not invariable, however, as severe injury has been recorded at all seasons and under a great variety of conditions. One record of 5,000 trees girdled in a large Kansas orchard is noteworthy, as all of this injury was done before the middle of December, during a mild open winter, with an abun-



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FIG. 4.—Base of a York Imperial apple tree 41 years old killed by pine mice.

dance of grain and grass present. Again, during the dry season in the fall of 1920, orchardists in California were greatly troubled by meadow mice, the loss in one orange grove being 1,300 trees. Such examples indicate the need of protection against mice at all seasons.

The kinds of crops damaged by mice are practically without limit, although orchard trees, nursery stock, small fruits, and shrubbery are probably injured the most. Little discrimination is shown by the mice in attacking fruit trees, although it seems probable that a mild preference is shown for apple trees and an antipathy for the bark of cherry trees. Recent reports from Connecticut tell of the destruction by field mice of nearly 60 per cent of an orchard of 9-year-old apple trees; the killing of 2,000 of the 3,000 pear trees in another orchard; and the total destruction of a plantation of 500 young peach trees. Shade and forest trees also are often damaged.

An investigation of the damage by these mice in a New York State park revealed serious injury to young hardwood trees and the complete girdling of over 1,000 6-year-old Scotch pines in a 5-acre block.

The succulent bark of the younger trees is preferred by the mice, but no tree is immune from their depredations when food is scarce. In a large orchard near Charleston, W. Va., over 1,000 trees, all of which were 18 years old, were killed by pine mice. Another large orchard near New York City sustained mouse injury entailing a loss of \$10,000 worth of trees, including a number of 50-year-old trees, which were completely girdled (fig. 4). This information is of particular importance to orchardists who consider their trees advanced in age beyond the limit of mouse injury.

To make an accurate estimate of the average national loss from field mice is not possible, but undoubtedly it runs into millions of



Fig. 5.—Abundant cover is an incentive to mouse injury. A poison cache at the base of the tree would afford protection against mice if it is desired to maintain the cover.

dollars annually. A number of years ago, through the agency of fruit-tree growing contests in Maine, records of a large number of young fruit trees revealed an annual mortality of 15 per cent, half of which was estimated to have been caused by the work of mice. A survey of orchards in Connecticut provided the basis for an estimate of the loss of nearly half a million dollars to orchardists through operations of field mice during the severe winter of 1919-20. Following this mouse plague, the Massachusetts Extension Service sent out a questionnaire to the fruit growers of the State, the returns from which showed a loss of \$125,000 in orchard trees. In the Valley of Virginia, following unusually severe injury by mice, an inspection of orchards in 1918 disclosed losses in excess of \$200,000 in a single county.

Damage to farm crops other than fruits is very common, but is less spectacular, except under plague conditions, and no general survey of injury has been made recently, although a great many cases of severe damage are on record. Root crops, tubers, and

bulbs are very attractive to mice, particularly to pine mice, and losses often approach in severity the losses from fruit-tree injuries. Mice are also fond of clover and alfalfa, and the aggregate loss in these crops is considerable. Cereals are damaged most heavily in the shock, but are subject to attack at all times.

PREVENTIVE MEASURES.

The control of field mice in orchards should be undertaken at stated intervals as a regular feature of orchard practice, just as spraying is done to combat insect pests or fruit diseases. The orchard should be carefully examined in the fall and early in spring

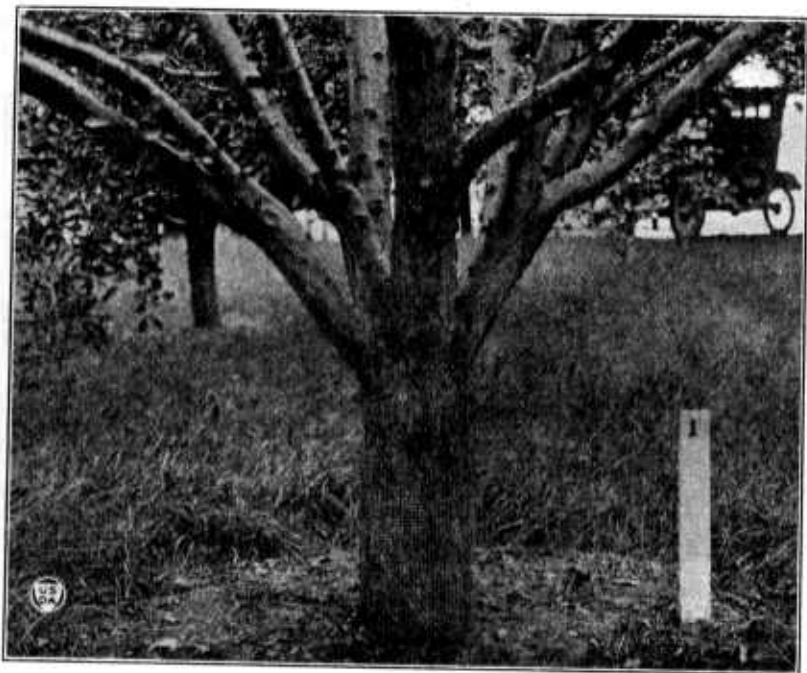


FIG. 6.—Wire screen of one-fourth-inch mesh for protection from mice and rabbits, showing also method of clearing shelter away from trees.

for mouse signs, and if any are found appropriate protective measures should be taken. Methods of preventing injury in orchards may be grouped in four classes: (1) Removing mouse shelter; (2) treating trees with washes to repel mice; (3) inclosing trees with mechanical protectors; and (4) killing the mice.

REMOVAL OF MOUSE SHELTER.

One method of controlling meadow mice, by taking advantage of their habit of hiding from their natural enemies, consists of removing all harborage from the vicinity of the tree requiring protection (fig. 5). Clean cultivation as practiced in many western orchards is generally successful in eliminating meadow mice, and it is also effective where pine mice are involved, because it destroys the normal

food supply as well as the surface shelter. The more usual practice of clearing away the cover from around the tree for only 6 feet or more in fall (fig. 6) undoubtedly affords some protection to the orchard, but as the base of the trees may be reached readily under cover of snow, it can not be relied upon at all seasons. Many orchardists, however, who depend on this method of protection from meadow mice remove or tramp down the snow after each fall.

USING REPELLENT WASHES.

Certain paints, smears, and washes are known to be objectionable to mice and have the advantage, when applied to the trunks of trees to a height of 18 inches or more, of being adapted to the prevention of injury by rabbits as well. One of the most deterrent and persistent of these is a mixture of about one part of creosote oil to two or three of coal tar (fig. 7), a preparation which the Bureau of Plant Industry has found to be a very successful waterproof and disinfectant wound paint. It is injurious to the soft bark of seedlings and to larger trees below the ground surface, and should not be applied to trees under two years of age.

The most common form of repellent is an undiluted lime-sulphur solution. While very useful, its effectiveness is short lived, and it must be renewed several times during the course of an average winter. The addition of a pound of glue to a gallon of the concentrated lime-sulphur will increase the adhesive and persistent qualities.

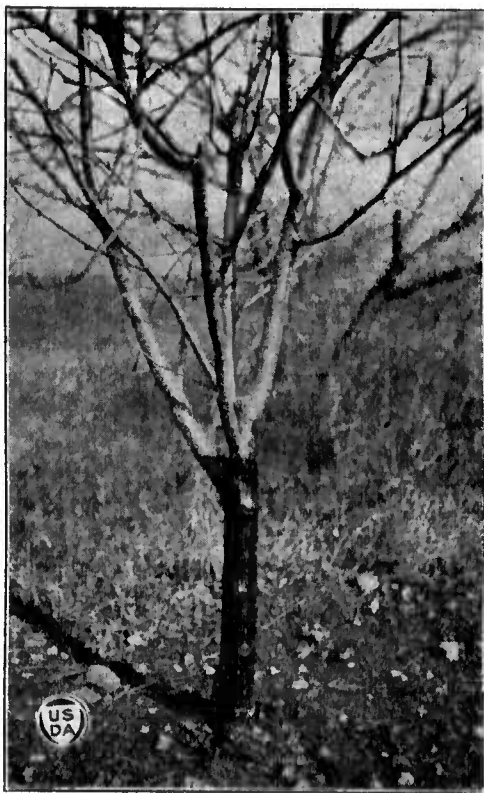


FIG. 7.—Apple tree treated with a coal-tar-creosote mixture. This preparation is found to be a repellent to mice.

MECHANICAL PROTECTION.

Encircling the bases of trees with woven wire or some other form of guard is one of the most common means of protection against mice in the Northern States. This practice has no value, however, where pine mice are concerned, as these mice attack the trees below the surface of the ground.

Woven wire netting of one-fourth inch mesh is probably the most practical guard used. (See fig. 6.) If cut to encircle the tree loosely to a height of 18 inches, it will afford protection against rabbits as well as mice.³ Wooden veneer, paper, and similar protectors are in common use during the winter months, but should be removed each spring, as they may harbor the larvæ of orchard pests. Window screening is sometimes used in Maine, as it is believed to protect the trees from borers as well as from mice and rabbits. Rolls 18 inches high are fitted loosely about the tree, with cotton or rags stuffed in at the top to prevent adult borers from getting to the base of the tree, where the eggs are usually deposited. Galvanized-wire screen dipped in paint is the most serviceable for the purpose.

Occasional complaints are made that mice get underneath or climb over the top of these mechanical contrivances. In one instance on record, every tree in a young orchard thus protected was killed by

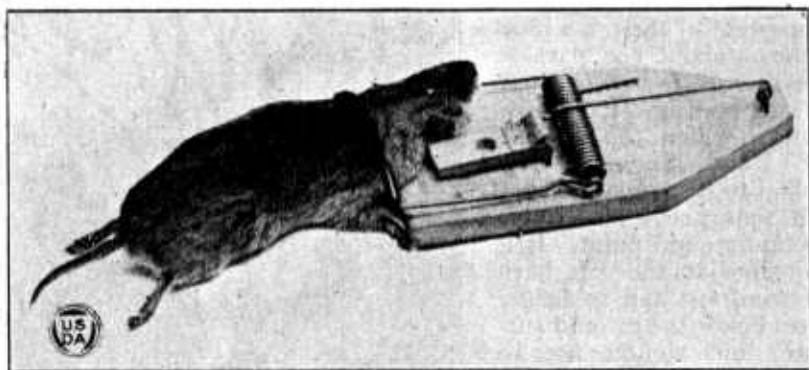


FIG. 8.—Field mouse caught in unbaited trap set in runway. Baiting with oatmeal or other grain baits, however, gives more consistent results.

meadow mice working on the branches under cover of a very deep snow.

DESTRUCTION OF FIELD MICE.

While deterrent measures are of undoubted value in reducing damage by meadow mice in orchards, they have little effect on pine mice. Furthermore, there is always the possibility that they will be rendered ineffective by very deep or drifted snow or by other unusual conditions. No insurance against mouse damage is so reliable as complete extermination of the mice; the protection thus obtained not only removes all apprehension of injury by field mice, but permits mulching and cover cropping. Many orchardists would follow these practices were it not for the increased damage from mouse depredations. In orchards the destruction of mice is recommended as the surest protective measure; it is the only way to prevent mouse injury to field crops. The two practical means of destroying mice are trapping and poisoning, and the methods recommended are equally applicable to both meadow mice and pine mice.

³ See Farmers' Bulletin No. 702, "Cottontail Rabbits in Relation to Trees and Farm Crops."

TRAPPING.

Field mice are readily caught in strong mouse snap-traps (fig. 8). They are relatively unsuspicious animals, and usually are easily exterminated by persistent trapping. In commercial orchards or on other large areas trapping is not economical, however, because of the large amount of labor involved. For areas not over an acre or two in extent, and where the use of poison is objectionable, trapping can be made very effective. The two essentials to success are plenty of strong traps and regular attention to them.

Traps should be set in the surface runways and at the entrance of burrows in such manner that the mouse in following its usual route will pass directly over the trigger. Mice may be thus trapped, even without the use of bait, although it is better to bait with oatmeal or other grain. In pine mouse runs it is well to remove enough dirt to set the top of the trap flush with the bottom of the run.

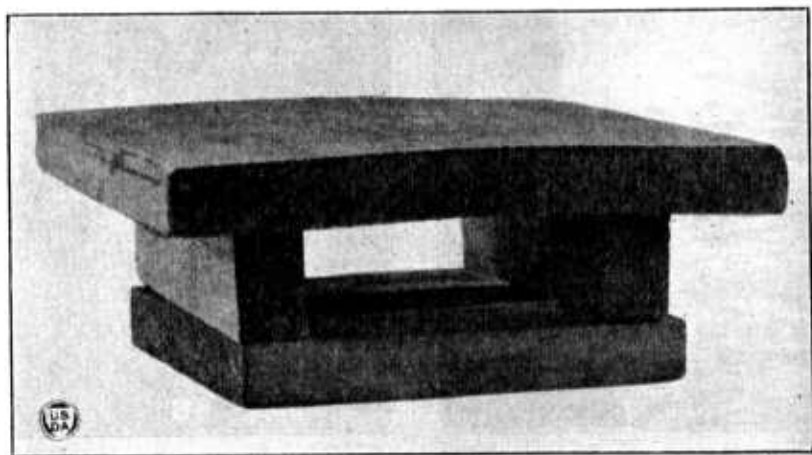


FIG. 9.—Simple wooden poison station for field mice, made of 1-inch material, the top 8 inches and the bottom 6 inches square, and the side strips 1 1/2 inches high. An important feature of this station is the one-half inch depression or groove to hold the poisoned bait, shown (darker) in the floor.

The place of setting can be marked for convenience in finding the trap by twisting a bit of cotton on a near-by weed or on a twig stuck into the ground.

POISONING.

By far the most satisfactory way of controlling field mice is by the use of poison. The Biological Survey has developed several formulas for preparing baits and directions for distributing them which have been found very effective when carefully followed. Wherever valuable trees or plants are to be protected it is highly desirable to maintain at all times a supply of effective poisoned bait. This may be accomplished through the use of baits with moisture-resistant coatings exposed in suitable containers, or "stations." When properly placed such baits will not only destroy the resident mice but will account for all mice that may move in from time to time. This method of poisoning is being followed in many eastern

orchards with very gratifying results and makes for both efficiency and economy.

Poison stations.—Recent experiments have demonstrated the value of a wooden poison station (fig. 9) that may be easily and cheaply constructed to make poisoned bait readily accessible to mice without exposing it to the weather. Square pieces of 1-by-8-inch boards are cut for the tops and of 1-by-6-inch boards for the bottoms. A depression to contain the poisoned bait is made across the bottom board with a chisel or, if made at a planing mill, by a group of circular saws. The two walls of the station are cut from 1-by-11½-inch strips into 6-inch lengths. The whole is fastened together with four nails. Mice are attracted to these poison stations and have often been observed running around them.

Drain tiles of 1½-inch diameter or larger (fig. 10, *B*) serve fairly well as poison stations, although they absorb moisture too freely in

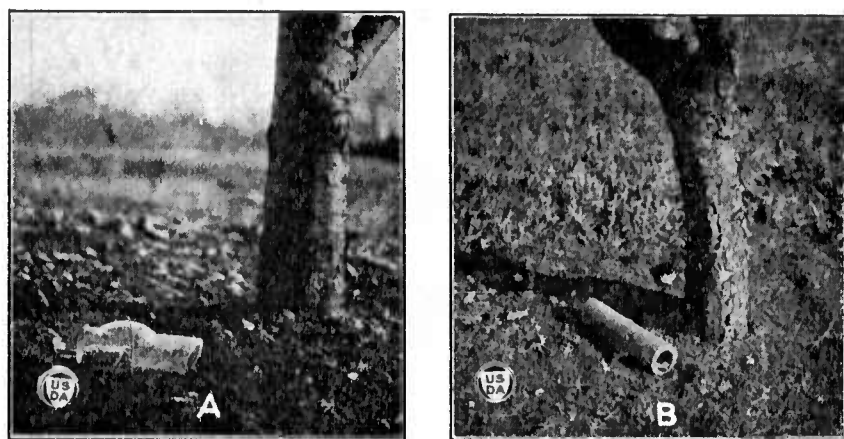


FIG. 10.—Poison stations made (A) of glass and (B) of tile. Others may be made by utilizing wide-mouthed glass bottles, glass jars, or tin cans, although wooden stations (fig. 9) seem to be entered more freely.

damp places and thus result in moldy baits. Another type of poison container, made of glass (fig. 10, *A*), which has found a ready market in fruit-producing sections of Virginia, is designed to allow the mice free access and yet prevent rain or standing water from getting in and the bait from spilling out.

Mice will enter wide-mouthed bottles and glass jars for food when it is scarce naturally, but not so freely as they do the wooden stations. Tin cans, though far less effective than wooden, glass, or tile containers, may be used temporarily in emergencies.

Poison stations should be set close to the base of the tree to escape cultivating machinery, and should be lightly covered with vegetation, prunings, or some other material that will afford shelter for the mice (fig. 11). They should be on high ground to avoid standing water and so placed that there will be a circulation of air to aid in keeping the baits dry and in good condition for long periods. The stations should be examined and refilled as required. This should be done at least twice a year—late in fall, again during the winter, and preferably also in spring. With poison stations prop-

erly placed, a maximum of protection is furnished at a minimum of labor and expense.

Rolled-oat bait.—The following preparation has been designed to meet the requirements for use as a permanent bait in poison stations or caches, and it has also proved highly satisfactory for general use:

Mix together, dry, $\frac{1}{2}$ ounce of powdered strychnine and $\frac{1}{2}$ ounce of baking soda. Sift the strychnine-soda mixture over 1 quart of rolled oats, stirring constantly to insure an even distribution of the poison through the grain. Thoroughly warm the poisoned rolled oats in an oven and sprinkle over them 6 tablespoonfuls of a mixture of 3 parts of melted beef fat and 1 part of melted paraffin, mixing until the oats are evenly coated. When the grain is cool it is ready for use.

If larger quantities of the bait are needed, use in the proportion of 1 ounce of strychnine, 1 ounce of soda, 8 quarts of rolled oats, and $1\frac{1}{4}$ pints of the beef-fat-paraffin mixture. In applying the coating it is very important that the beef-fat-paraffin mixture be hot and the poisoned rolled oats thoroughly warm, otherwise it will not be possible to obtain an even coating.

Teaspoonful quantities of the poisoned rolled oats should be placed in the small containers or stations described, well distributed over the infested area. The poisoned bait may

also be scattered along runways and within entrances of burrows, a teaspoonful at a place. In orchards where mice are abundant it is advisable to place one "poison station" under each tree.

Starch-coated grain bait.—Poisoned grain prepared by the following formula is adapted for treating forage-crop or cereal-crop areas where mice are abundant:

Mix 1 tablespoonful of gloss starch in $\frac{1}{2}$ teacup of cold water and stir into $\frac{1}{2}$ pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strychnine with 1 ounce baking soda and stir into the starch to a smooth



FIG. 11.—Wooden poison station properly placed to protect tree.

creamy mass free of lumps. Stir in $\frac{1}{2}$ pint of heavy corn sirup and 1 tablespoonful of glycerine. Apply to 12 quarts of wheat or to 20 quarts of steam-crushed whole oats and mix thoroughly to coat each kernel.

Steam-crushed whole oats are preferable, as they may be distributed promiscuously over the infested area without endangering bird life. Wheat, however, should be placed inside the mouse tun-



FIG. 12.—Dirt removed to expose pine-mouse injury prior to bridge grafting.

nel openings, under dense cover, or in the poison stations described. Strychnine-poisoned grain will not endanger livestock if properly scattered.

Sweet-potato bait.—A convenient bait, and one well adapted for poisoning pine mice on small areas, is prepared as follows:

Cut 3 quarts of sweet potatoes into $\frac{1}{2}$ -inch cubes. Mix $\frac{1}{4}$ ounce of powdered strychnine and $\frac{1}{4}$ ounce of baking soda and, using a pepper box, sift this over the freshly cut potatoes, stirring the mixture constantly to distribute the poison evenly. Use the bait while it is fresh.

One or two pieces of the potato bait should be dropped into the mouse tunnel through the natural openings or through openings made with the finger or a stick. Mole runways should be similarly treated in order to poison the pine mice which they usually harbor. After a few days the area should be carefully examined for fresh signs of mice, and if any are found the poisoning should be repeated.

NATURAL ENEMIES OF MICE.

In making plans for the permanent control of field mice, a protective sentiment should be fostered toward such of their natural enemies as are not injurious to the interests of man, for mice form an important item of the diet of many of our predatory birds, mammals, and larger snakes. Whenever there is an abnormal increase in the number of mice, their enemies usually tend to increase correspondingly and thus exercise a natural control over them.

The birds which most commonly feed upon field mice are owls, hawks,⁴ shrikes, cranes, herons, ibises, gulls, crows, magpies, and road-runners. Among their mammal enemies, which are for the



Fig. 13.—Apple tree girdled by pine mice but saved by bridge grafting.

⁴For information regarding the value of hawks and owls to agriculture, see Circular No. 61 of the Biological Survey, U. S. Department of Agriculture, "Hawks and Owls from the Standpoint of the Farmer."

most part economically beneficial to the interests of man, may be mentioned foxes, badgers, raccoons, opossums, skunks, minks, martens, weasels, and shrews. Their enemies among the larger snakes include kingsnakes, bullsnakes, and blacksnakes.

CARE OF INJURED TREES.

Trees slightly damaged by field mice will usually soon recover if the injured parts are completely covered by mounding up soil around the bases or if paint or other material is used to prevent the wounds from drying out. When the injury is severe or the trees are entirely girdled (fig. 12), bridge-grafting should be resorted to.⁵ Following the severe mouse epidemic of 1919-20 in Massachusetts, a number of fruit specialists of the State Agricultural College successfully directed the work of bridge-grafting 13,000 trees, valued at \$90,000 (fig. 13).

Preventive measures are preferable to remedies for damaged trees, but prevention is not always possible. When mouse damage occurs in orchards, great losses may often be averted by the prompt treatment of the injured trees.

COOPERATION IN MOUSE CONTROL.

When field mice become so excessively abundant as to menace the fruit trees and crops of a whole community, concerted effort of all the residents is required to control the situation and possibly to avert a disastrous plague of mice.

A serious outbreak of mice in 1922 in the famous fruit-growing sections of the State of Washington was promptly checked through a cooperative poisoning campaign organized under the supervision of specialists of the Biological Survey working in cooperation with the extension service of the State College of Washington. Twenty-two thousand pounds of poisoned baits were prepared and distributed with telling effect by 750 orchardists in one county alone. The United States Department of Agriculture stands ready to assist as far as possible in the organization of such undertakings.

⁵ See Farmers' Bulletin No. 1369, "Bridge Grafting."

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